

AUGUST 5, 1985

CHEMICAL & ENGINEERING

NEWS

A1850-1
Outlook mixed for carbon
black and titanium dioxide
A Key Chemicals Review Page 13

**Foreign investment
shows new strength
in U.S. chemicals**

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News of the Week

■ **Union Carbide consolidates business segments in move to streamline management, asks for dismissal of Bhopal-related suits filed in New York.** Page 6

■ **Two labor groups dispute Union Carbide's explanation of the Bhopal disaster.** Page 7

■ **Three candidates are nominated by petition to run in ACS's fall election.** Page 7

■ **Last-minute efforts to save the Great Plains coal gasification plant fail.** Page 8

■ **"Long-shots" in engineering research get a boost from new NSF funding approach.** Page 8

Cover: Interox America's newly expanded hydrogen peroxide plant in Deer Park, Tex.

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Business

Demand for major pigments carbon black and titanium dioxide will grow slowly worldwide; U.S. outlook is mixed. Page 13

Government

House has moved on most agency R&D budgets for fiscal 1986, increasing some and cutting others. Page 17

Science

New chiral boranes developed that could usher in a third generation of asymmetric organic synthesis. Page 22

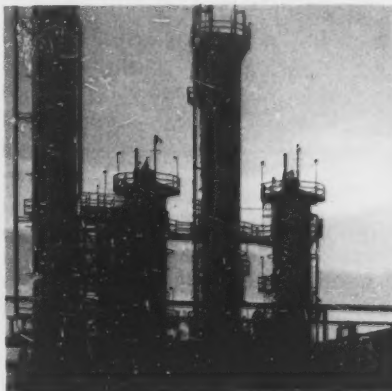
Method for determining bond lengths in solids that lack long-range order devised by researchers. Page 23

Administration's Star Wars concept draws heavy criticism in study by American Academy of Arts & Sciences. Page 26

Program to license more engineers in U.S. launched by National Council of Engineering Examiners. Page 28

ACS News

Two petitions are up for council action at the Chicago meeting: one on subscription prices, one on divisional councilors. Page 32



News Focus

Investment in U.S. chemical companies by foreign firms is increasing again, with some large and costly acquisitions in past few months. Page 9

Major Pigments Gain Global Commodity Status

Though worldwide demand for carbon black and titanium dioxide will grow slowly, U.S. outlook is mixed, with carbon black use to continue decline

Bruce F. Greek, C&EN Houston

Carbon black and titanium dioxide are becoming worldwide commodities as their international trade grows in a fashion similar to many other chemicals. In the future, U.S. producers will be facing greater competition from imports while exporting less. Prices of these two commodities are high enough to make shipping as a percentage of total cost relatively low, permitting this trade.

These changes to the worldwide demand and supply situation are causing U.S. producers to buy or build plants outside the U.S. Producers, as a result, are sometimes able to make their product abroad at lower cost than in the U.S., and they are able to sell more profitably in and outside the U.S., compared to their U.S. operations. Factors other than actual production costs, such as the strength of the dollar, can be very important in profitability.

Worldwide consumption of both of these materials, for the longer term, will tend to grow slowly. Of the two, carbon black may have the lower growth rate over the next five years at about 1% annually. The growth rate for titanium dioxide, however, will not be much higher, at 1.5% annually, according to some industry sources.

In the U.S., growth in consumption for carbon black has been forecast to be lower than worldwide

growth because demand for tires and nontire automotive elastomeric products could continue a decline that began last year. Toward the end of this decade, the decline in demand for carbon black likely will slow and then reverse to slow growth. Imports of carbon black probably will continue to increase and fill a growing part of the U.S. consumption. As a result, U.S. production of carbon black could go

smaller total volume and higher imports than does carbon black. Like carbon black going to tires, titanium dioxide will continue to have a single and very slowly growing major use—that of surface coatings. As a result, it will have a low growth in consumption. In other parts of the world, especially in developing countries, demand for paints will grow much more rapidly than in the U.S. In these countries, demand for titanium dioxide could grow at rates of 2 to 5% annually.

Titanium dioxide's growth rate is small, but higher than that for carbon black. Thus this rate likely will result in full utilization of world capacity sooner than will carbon black's. Ores from which titanium dioxide is made are available in many places of the world. Thus, new plants are likely to be built in various countries outside the U.S.

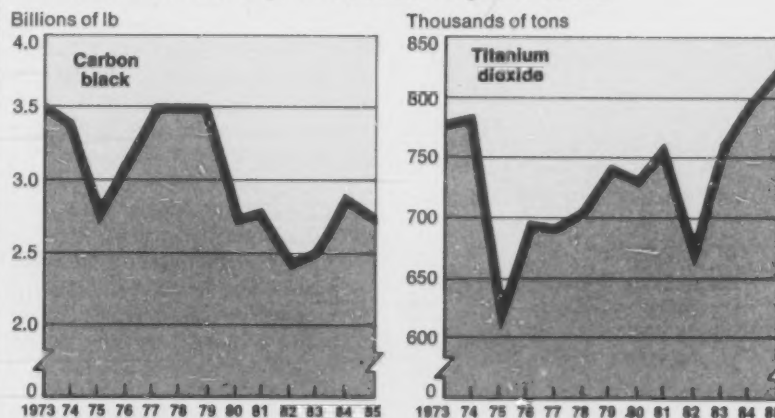
For details of the near-term outlook for carbon black and titanium dioxide, please see the following pages.

Key Chemicals

on hold after ending the decline that is now under way. Therefore, a return to production levels in the 3.5 billion lb-per-year range of the 1970s now seems to be unlikely. Major capacity expansions would be needed, and these can't be justified economically at present levels of profitability.

The outlook for titanium dioxide is somewhat similar but involves

Carbon black output remains below previous highs as titanium dioxide output exceeds 10-year record



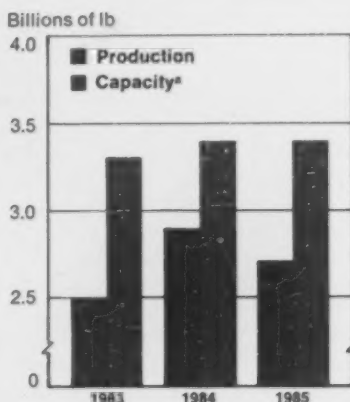
Sources: Department of Commerce, industry and C&EN estimates

Carbon black

C

- Demand slowing
- Capacity declining
- Prices may drop

PRODUCTION/CAPACITY



a First quarter.

MAJOR PRODUCERS

Ashland Chemicals, Cabot, Columbian Chemicals, J. M. Huber, Phillips Petroleum

HOW MADE

Partial oxidation of heavy petroleum fractions

MAJOR END USES (U.S.)

Tires 65%, other fabricated rubber products 25%, colorant and filler for plastics, inks, etc. 10%

FOREIGN TRADE

Exports—small, may reach 75 million lb in 1985, imports—rising, may exceed 150 million lb in 1985

PRICES

Range from 29 to 39 cents per lb, depending on grade

Production of carbon black has slowed this year after staging a two-year recovery from the recession. Output in 1985 could total 2.7 billion lb, down about 7% from 1984 production of just less than 2.9 billion lb. Even so, this decline would leave production ahead of the 2.5 billion lb in 1983.

The pigment's lag in production began in the first quarter of 1985 and accelerated in the second quarter. Predominant among the causes is the well-known increasing life-span of passenger car and light truck tires. This trend, which reduces demand for carbon black, is expected by many in the rubber and tire industries to continue in the next several years.

Capacity to make carbon black has declined this year. At the beginning of the second quarter, about 100 million lb of capacity located near Conroe, Tex., was shut down by Columbian Chemicals. An additional 150 million lb per year is on stand-by. The small expansions expected this year will add only 25 million to 50 million lb to the nameplate capacity total.

The net in-place capacity at the beginning of this year totaled a bit more than 3.4 billion lb. At the beginning of 1986, this capacity will have declined to 3.3 billion lb, with stand-by capacity almost unchanged. At that time, the operating capacity is expected to be about 3.2 billion lb.

Throughout 1985, nameplate capacity will average 3.3 billion lb, with operating capacity about 3.15 billion lb. If production does reach 2.7 billion lb, the operating rate will be 82% of nameplate capacity and 86% of effective capacity. These rates, although not as high as in some years of the 1970s, are well above recession levels.

In view of this operating rate, carbon black producers likely can't do much to increase their profits, especially with rising imports. Actual prices for carbon black could decline if crude oil prices decline. Consumers of carbon black are similar to consumers of all other products made from petrole-

um in that they expect raw material cost reductions to be passed on to them immediately if not before the cost declines.

Producers also face a short-term decline in demand for carbon black because of a decline in the production of tires, caused by the lower sales of replacement tires as tire life is increased. Another decline in the amount of rubber sold in tires for new cars has largely ended with the nearly complete use of the small-size spare tires or inflatable spare tires. The drop in replacement tire demand results from consumer willingness to buy better tires—particularly radial tires, which have much greater tread life. In addition, a trend toward better care of tires and the higher inflation pressures are helping extend tread life.

Other uses of rubber in cars and trucks also are showing little growth. The reasons are similar to those that are causing lower use of rubber in tires—smaller sized vehicles, which reduces the amount of weather stripping and gasketing per unit. Some competition from plastics may be reducing rubber demand slightly, but most of the market capture by plastics is over.

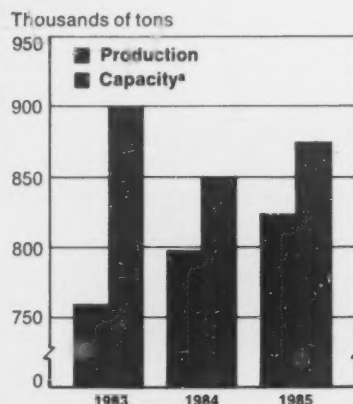
Nonautomotive uses of rubber and carbon black are relatively small. Their prospects are diverse. Use in industrial belting and hoses depends directly on heavy industrial operations, which generally seem to be experiencing little if any growth. One application is growing rapidly from a small base: that of single-ply roofing made of ethylene-propylene-diene rubber. This product continues to be improved and to be demonstrated as more cost effective than are other kinds of roofing.

A number of other uses of carbon black, such as in inks, paints, and plastics, all are small and are growing at low rates. None will significantly affect the total demand for carbon black, which leaves the developing roofing application as the best prospect to offset the declines in demand for automotive uses of the product.

Titanium dioxide

- **Demand strong**
- **Capacity growing**
- **Prices firm**

PRODUCTION/CAPACITY



a First quarter.

MAJOR PRODUCERS

Du Pont, Kemira Oy, Kerr-McGee, SCM

HOW MADE

Recovery from natural or synthetic ores using chlorine, carbon (coke), and oxygen, or sulfuric acid

MAJOR END USES

Surface coatings 50%, paper coatings 25%, plastics colorant 15%

FOREIGN TRADE

Exports—to hold at about 175,000 tons in 1985, imports—to decline to about 180,000 tons in 1985

PRICES

70 cents per lb for anatase grade, and 75 cents per lb for rutile grade

Titanium dioxide, often considered to be a mature product, has several active developments under way. Production is pressing capacity. U.S. demand well exceeds production, but imports making up the difference may decline in 1985, possibly causing further tightening of supplies. Furthermore, a change in ownership of some U.S. capacity has occurred recently.

Production of titanium dioxide in 1985 will total 825,000 tons. The period of greatest strain on capacity is almost over for this year, after which a better estimate of the potential production for the year can be made. Seasonality of production always causes difficulties in estimating annual production early in the year.

Traditionally, the greatest demand for titanium dioxide occurs during the second and third quarters. Producers generally have to draw upon inventories to meet demands, which may be greater than production capability. Then during the fourth and first quarters of a year, they rebuild inventories. To some degree, output in 1985 will depend on the willingness of producers and consumers to carry inventory through the next winter in anticipation of demands expected next spring and summer.

Demand for titanium dioxide in the U.S. will surpass 900,000 tons in 1985. Besides actual production, this demand will be met because imports will exceed exports and because there will be possibly some decline in inventories. Imports, however, are forecast to be lower than in 1984, accounting for some of the tightness of supply. Most titanium dioxide imports come from Europe where there is surplus capacity. The economic recovery in Europe is allowing producers there to increase sales to local markets, which reduces the quantity available for export. Exports from the U.S. aren't expected to change much, mainly because no more supplies will be available for export.

The list of titanium dioxide producers continues to change. This year American Cyanamid opted to sell its

business to a Finnish company, Kemira Oy, which will continue production.

Such changes in ownership and in plant operation have, over the years, altered capacity as well. Following shut-down of some old capacity that used technology involving reactions with sulfuric acid—which leads to much higher costs to control pollution—total capacity has been growing. Du Pont has completed a new titanium dioxide plant at De Lise, Miss.—the only new one built in some years. However, capacity additions have been mainly through debottlenecking expansions. This year, for example, Kerr-McGee is adding more than 8000 tons of annual capacity to its plant at Hamilton, Miss., with startup expected in early 1986.

The nameplate total of in-place operating capacity at the beginning of 1985 was 875,000 tons, possibly a bit more. If production in 1985 reaches 825,000 tons, then plants will have an average operating rate of almost 95% for the year. This high level of operation indicates that some advances in process techniques and additional debottlenecking have occurred.

Strong demand for titanium dioxide in all of its major uses is behind the full operation of plants and the lingering tightness in supply. About half of U.S. consumption is in surface coatings, with architectural coatings (mainly exterior and interior residential paints) accounting for nearly two thirds of this share. Another quarter of surface coating use goes for original equipment manufacture, largely for items such as appliances, machinery, transportation equipment, and metal furniture and fixtures.

The other major applications of titanium dioxide are in paper coatings and in plastics. Both of these uses have grown faster than has the demand for use in surface coatings, but their base is smaller. Longer-term, these uses, and some of the small miscellaneous ones such as in ceramics, will account for most of the increase in demand for titanium dioxide.

Congress Finally Moves on Fiscal 1986 Money Bills

By adjournment, House had approved spending levels for most major research funding agencies, deviating frequently from Administration requests

Janice R. Long, C&EN Washington

The House didn't set any efficiency record this year in moving fiscal 1986 money bills. In the past two years, it completed action on 11 of the 13 regular appropriation bills by the middle of June. This year it was the middle of July before any of them came up for a floor vote.

The holdup was caused by Congress' inability to agree on a first budget resolution. More than a decade ago, Congress set up a formal budget process that called for adoption by May 15 of a so-called first budget resolution setting a target limit on federal spending and priorities for the way those funds would be spent. To make sure that the limits would have real meaning, Section 302(a) of the Congressional Budget Act says that spending legislation—appropriation bills—cannot be considered until Congress has agreed on the budget resolution.

That process worked fairly well until this year. However, when a budget resolution was not forthcoming by July 24, the House, on a party line vote, decided to suspend Section 302(a) of the budget act. That broke the logjam, and the appropriations bills moved swiftly. By the time it adjourned for its annual August vacation, the House had approved fiscal 1986 spending levels for all but two of the major research funding agencies—the Department of Defense and the National Institutes of Health.

As usual, the House set its own budget priorities, adding funds above the Administration request for some programs and subtracting funds from other ones. Even when the totals come close to being the same, the budget items the House emphasized quite often aren't the same as those the Administration emphasized.

One good example of this tinker-

ing can be found in the Department of Energy's R&D budget, which was part of the first House-passed appropriation bill. The House allowed a total of \$4.2 billion, 1% less than DOE has available this year but 1% more than the Administration requested. However, the Administration wanted an 18% increase in DOE's weapons R&D budget. It got a 4% increase. It wanted to cut

House boosts a few R&D budgets, cuts others

\$ Millions	1986		1985	% change 1985-86
	Appropriation	Request		
NASA	\$ 7,666.0	\$ 7,886.0	\$ 7,491.4	2%
Space flight control and data communications	3,402.9	3,509.9	3,601.8	-6
R&D	2,756.8	2,881.8	2,422.6	14
Management activities	1,367.0	1,345.0	1,317.0	4
Facilities	139.3	149.3	150.0	-8
Energy	4,181.9	4,153.9	4,226.3	-1
Energy supply R&D	1,939.6	1,955.4	2,018.2	-4
Nuclear	607.6	657.6	623.0	-3
Supporting research and technical analysis	514.0	480.8	477.8	7
Magnetic fusion	385.0	390.0	437.0	-12
Environment	229.7	227.7	230.5	—
Solar	147.0	148.0	178.0	-17
Electric energy systems and storage	30.1	26.1	40.1	-25
Geothermal	26.2	25.2	31.8	-18
Weapons R&D	1,072.4	1,211.6	1,027.3	4
General science and research	685.5	685.4	730.0	-6
Fossil R&D	299.5	160.5	274.9	9
Conservation R&D	184.9	141.0	175.2	5
NSF	1,522.9	1,568.4	1,499.0	1
Research and related activities	1,347.2	1,397.7	1,301.9	3
Antarctic programs	115.1	120.1	110.1	4
Science education activities	60.6	50.6	87.0	-30
EPA	1,491.2	1,362.6	1,309.8	14
Salaries and expenses ^a	690.2	654.7	656.3	5
Abatement, control, and compliance	577.6	495.5	460.5	25
R&D	223.4	212.4	193.0	16
Commerce	1,329.9	1,139.0	1,337.3	-1
NOAA	1,121.2	934.3	1,113.1	1
NBS	124.0	120.0	124.0	—
PTO	84.7	84.7	100.2	-16
USDA	905.5	849.8	912.4	-1
Agricultural Research Service	492.8	483.3	494.1	—
Cooperative State Research Service	276.4	251.2	285.8	-4
Forest Service Research	125.0	104.2	121.0	3
National Agricultural Library	11.3	11.1	11.5	-2
FDA	419.7	409.1	414.8	1
TOTAL	\$17,517.1	\$17,368.8	\$17,191.0	2%

^a Includes in-house research funding.

the fossil R&D budget 42%, the House opted for a 9% raise. And the House added a new category to the DOE budget—the clean coal technology reserve—funded by a three-year \$750 million transfer from the embattled Synthetic Fuels Corp. Projects financed by the reserve are to be cost-shared by industry.

The House also approved a 7% increase for supporting research and technical analysis, instead of the requested 1% increase. Among the additions in that budget category was \$2 million added to the \$94.2 million budget request for chemical sciences to support increased activities in the fundamental chemistry of energy processes at Argonne National Laboratory. The House also added \$14 million to the \$183 million materials science budget request, including \$12 million for completion of the National Center for Chemical Research at Catholic University, \$6 million to support establishment of a Center for Science & Technology at Atlanta University, and \$5 million to support a competition for development of proposals for a 6-GeV synchrotron light source. However, the House cut \$8 million from the \$17.4 million requested for the Lawrence Berkeley Center for Advanced Materials Research.

Next up for a floor vote was the appropriation bill that includes the Commerce Department. The House flatly rejected the Administration-proposed 15% decrease in funding for the National Oceanic & Atmospheric Administration's operation, research, and facilities budget, and instead approved an essentially level budget of \$1.1 billion. That allows for salvage of the sea grant program, coastal zone management grants, and the Great Lakes Environmental Research Laboratory and the National Underseas Research program, all of which were slated for termination. The House held the National Bureau of Standards budget level at \$124 million, once again saving the Center for Fire Research and the Center for Building Technology, but disallowing the \$8 million requested for construction of a cold neutron research facility. The House did go along with the Administration's plan to cut the Pat-

ent & Trademark Office budget 16% to \$84.7 million. The decrease is supposed to be offset by increased processing fees that Congress has yet to approve.

The House-approved funding level for the National Science Foundation is \$1.5 billion, 3% less than the budget request and a scant 1% above current funding levels. On paper the research and related activities budget gets a 3%, rather than the requested 7%, increase to \$1.3 billion. The House directed that the reduction be applied to capital improvement projects such as the Cornell Electron Storage Ring, the Wisconsin Synchrotron Center, and the Very Long Baseline Array. It notes that relief from the hard freeze on NSF's budget called for in the budget resolution was possible because of a deferral of \$31.4 million in the fiscal 1985 science education budget, funds which can be applied to research and related activities in fiscal 1986. Meanwhile, the science education budget is \$60.6 million, 20% more than the budget request.

The National Aeronautics & Space Administration's budget is set at \$7.7 billion, 2% over current levels but 3% less than requested. However, NASA's R&D budget is up 14% to \$2.8 billion. That includes \$200 million for the space station, \$129 million for an upper atmospheric research satellite, \$128 million for the space telescope, and \$87.3 million for the gamma ray observatory.

The Environmental Protection Agency's extramural R&D budget is up 16% to \$223 million, 5% more than requested. The House added \$5 million to the request for grants and centers to maintain exploratory research at the current level, \$4 million for hazardous waste and groundwater research, \$3 million for total exposure assessment studies of toxic pollutants, and \$2.5 million for indoor air pollution research. However, it deleted \$10 million from the request for acid rain research, because as the Appropriations Committee put it, "The 60% increase proposed in the 1986 acid rain program is excessive—and a poor excuse for inaction on acid rain controls."

The Department of Agriculture's research programs did not fare as well as EPA's and NASA's; in ag-

gregate they are down 1% to \$906 million. But then the Administration wanted to cut them 7%. Funding for the Agricultural Research Service is set at \$493 million, including \$200,000 for continued assessment of dioxin contamination in the Great Lakes food chain, \$500,000 for establishment of a catfish breeding, genetics, and endocrinology program at the Delta States Research Center, and \$1.1 million for plant stress and water conservation research at Texas Tech University. The Cooperative State Research Service gets \$276 million, including \$34 million for competitive research grants. Of that amount, which is 25% below current-year funding, \$20 million is earmarked for biotechnology, \$16.5 million for plant science, \$4.5 million for animal science, and \$3 million for pest science.

The House once again refused to go along with a significant cut back in Forest Service research programs, approving a 3% increase to \$125 million rather than the proposed 14% cut. That amount includes \$12 million for acid rain research, with \$5 million going for terrestrial effects research; \$4 million for the competitive grants research program; and almost \$2 million for research on insects and disease.

The Food & Drug Administration's budget, which for some reason is included in the Agriculture appropriation bill, is set at \$420 million, 3% more than requested and 1% more than is available this year. A floor amendment provided \$2 million to develop and improve screening tests for Acquired Immune Deficiency Syndrome and to review and approve new diagnostic and treatment products. The AIDS money is part of \$37 million in additional funding that the Administration is requesting in fiscal 1986 for research on the disease. The remainder of the funding will be included in the Labor-Health & Human Services appropriation bill.

Of course the House does not have the last say in setting agency budgets. The Senate, which in recent years has been slightly more generous where research programs are concerned, is still to be heard from. □